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A SYSTEM DYNAMICS APPROACH FOR MODELLING MONETARY POLICY OF UKRAINE

The primary aim of this thesis is to develop a robust model that effectively illustrates the process of monetary policy and inflation targeting in Ukraine. In general, countries, which conduct the inflation-targeting regime, build the QPM, and the key policy rate is defined by the Taylor rule [2]. It is a widely used monetary policy rule that provides a guideline for central banks to determine an appropriate level of short-term interest rates based on macroeconomic indicators. This rule was proposed by economist John B. Taylor in 1993 as a simple and practical way to guide monetary policy decisions. The basis of the Taylor rule rests on the principle that central banks should adjust interest rates in response to changes in economic conditions, particularly inflation, and output. The rule suggests that the central bank should set its target interest rate based on two key factors: inflation and output gaps [3]. In our case, inflation is endogenized variable upon which we build our model, and want to understand how it will be behaving in the future to understand what policies should be implemented to put Ukraine on the path of slow and constant inflation at 5%. At the same time, the output gap is taken as an exogenous one, and it is calculated using the HP filter. The weights of each indicator are based on the regression that is part of the simulation system model.

Figure 1 depicts the influence of inflation on the key policy rate, considering the GDP gap. Inflation is defined by the influence of inflation expectation**s** [2]. The key policy rate is defined according to Taylor`s rule, which is a guideline used in monetary policy to determine the appropriate interest rate adjustment by central banks. It suggests that the central bank should set its policy rate based on two

factors: the inflation gap and the GDP gap. The rule states that when inflation rises above the target, the central bank should raise interest rates, and when the output exceeds its potential, the central bank should lower interest rates. By following Taylor's rule, central banks aim to maintain price stability while promoting economic growth and stability [5]. The regression to define the indicated policy rate was used with the mean of econometrics, and it has a high R^2 and all variables are statistically significant, meaning that p-values are less than 0,1. Also, the war shock was included to represent the rapid increase of the key policy rate by 15 p.p. in the middle of 2022 to ensure the financial welfare of local households in hryvnia, enhance the attractiveness of domestic currency investments, ease pressure on the foreign exchange market, and thus bolster the central bank's capacity to maintain stability in exchange rates and mitigate inflationary pressures during a full-scale invasion [4].

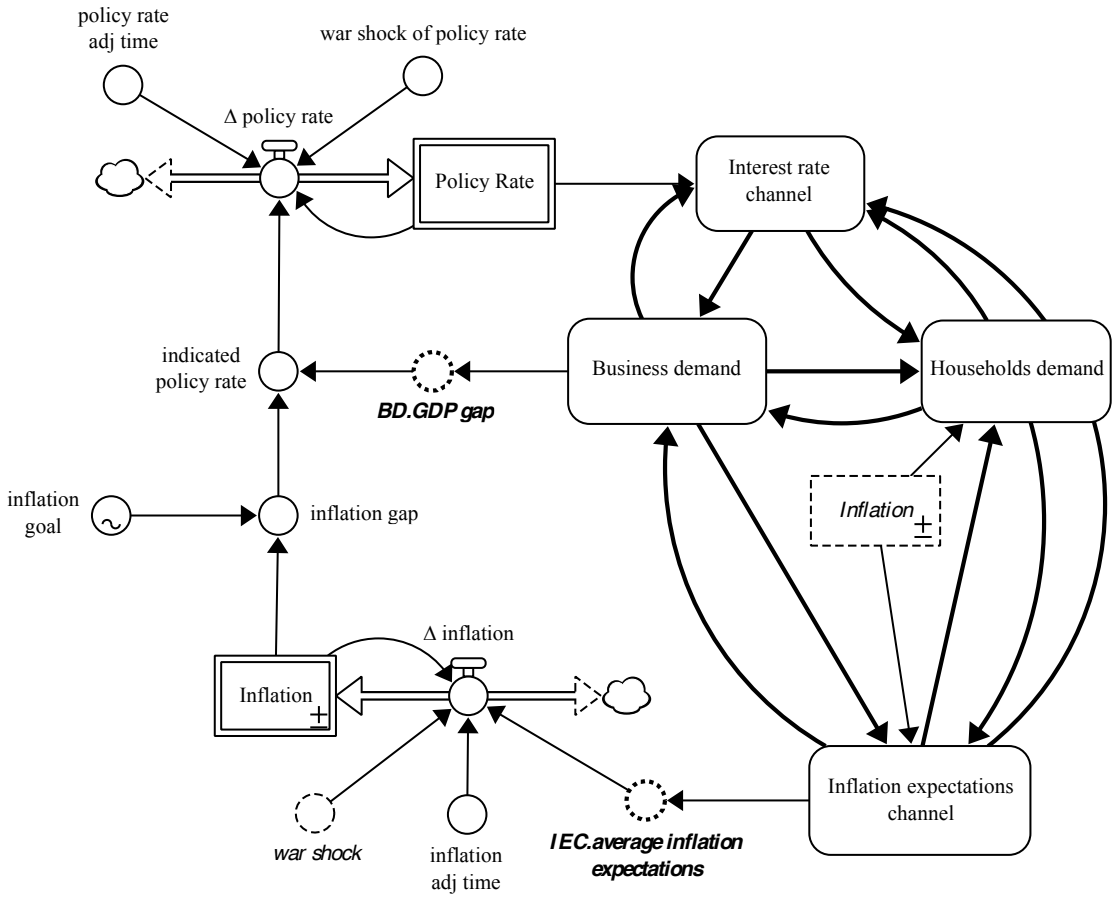

Figure 1. The monetary policy model of Ukraine

Additionally, Figure 1 depicts four sub-models: Interest rate channel, Business demand. Household demand, and Inflation expectations channel. Each of these sectors plays a vital role in transmitting the key policy rate, and we will look at them one by one.

The main loop, which acts as the driving force for this model, revolves around the intricate relationship between inflation expectations, the key policy rate, other interest rates such as interbank, lending, and deposit rates, as well as the propensity to consume, ultimately leading back to inflation expectations (see Figure 2).

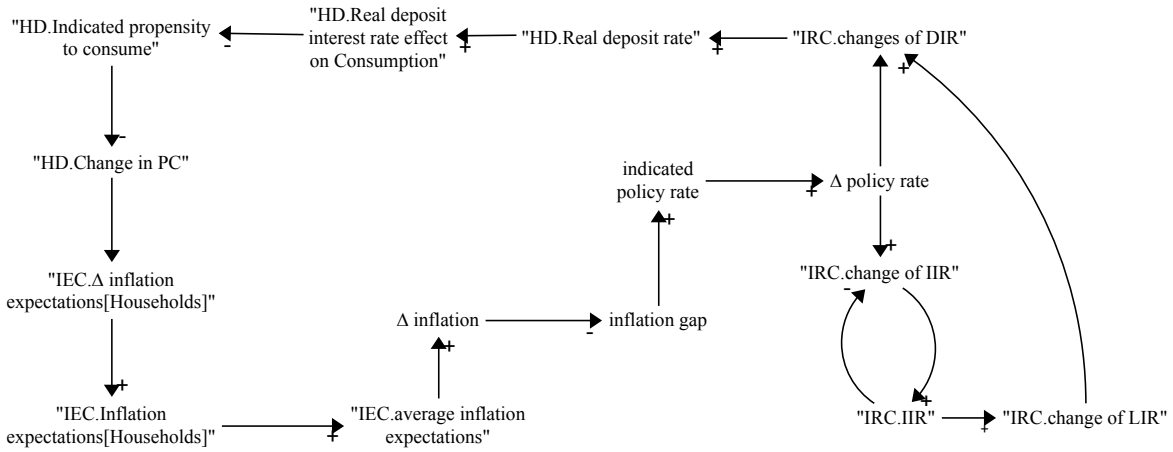

Figure 2. A feedback loop of inflation expectations, policy rates, interest rates, and consumption

At its core, inflation expectations play a pivotal role in shaping the overall inflationary environment. When individuals and market participants anticipate higher inflation in the future, they adjust their behavior and financial decisions, accordingly, leading to its rise. When inflation rises, it creates a positive inflation gap, meaning that the forecasted inflation deviates from a target value. In that case, the central bank usually responds by increasing the policy rate to dampen inflationary pressures. Conversely, if the inflation gap is negative, central banks may lower the policy rate to stimulate economic growth.

Changes in the key policy rate subsequently affect other interest rates, such as interbank rates, lending rates, and deposit rates. When the policy rate increases, it tends to raise borrowing costs across the financial system, leading to higher interbank interest rates, which, in turn, leads to the increase of lending and later

deposit interest rates. On the other hand, a decrease in the policy rate can lead to reduced interest rates, making borrowing more affordable, and deposits less attractive.

The impact of the real deposit interest rate on the propensity to consume is another crucial link in this loop. When the real deposit interest rate is positive, it increases the return on savings in real terms. As a result, saving becomes more attractive to consumers, leading them to allocate a larger portion of their income toward saving rather than consumption. This reduction in consumption can contribute to lower aggregate demand in the economy, potentially leading to a decrease in prices and inflationary pressures. Conversely, the negative value of the real deposit interest rate discourages saving, as individuals find it less attractive to save their money in negative-yield deposits. Increased consumption resulting from a low real deposit interest rate can contribute to elevated aggregate demand, creating the potential for price increases and inflation to occur.

Thus, the interconnectedness between inflation expectations, key policy rates, other interest rates, and the propensity to consume forms a continuous loop that shapes and influences the overall inflationary dynamics and economic conditions.

Another loop that reinforces and drives this model revolves around the influence of the key policy rate on other interest rates, including interbank rates, lending rates, and deposit rates. These interest rates, in turn, have significant effects on the real deposit interest rate, which plays a crucial role in shaping the propensity to consume, GDP, and the GDP gap, leading back to the key policy rate (Figure 3).

At the center of this loop is the key policy rate, which is set by central banks to regulate borrowing costs, manage inflation, and influence economic activity. When the key policy rate is adjusted, it has a ripple effect on other interest rates across the financial system. An increase in the key policy rate tends to raise interbank rates, lending rates, and deposit rates, making borrowing more expensive and impacting the overall cost of credit.

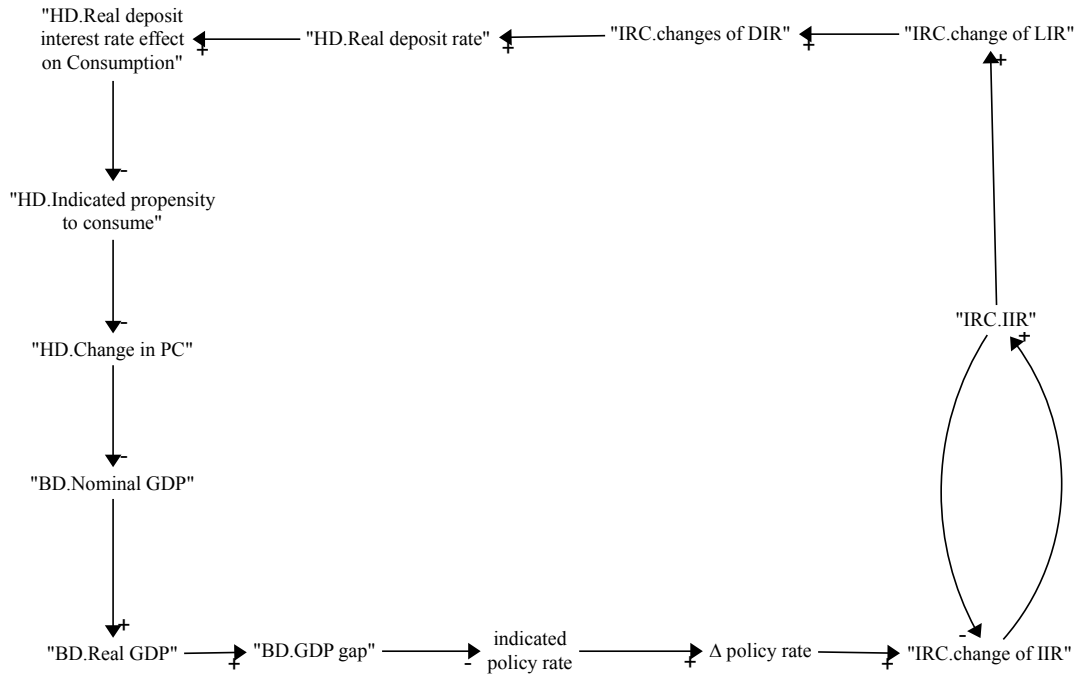

Figure 3. Feedback loop involving the key policy rate, other interest rates, the real deposit interest rate, the propensity to consume, GDP, and the GDP gap

The real deposit interest rate, which considers inflation, is a crucial factor influencing the propensity to consume. When the real deposit interest rate is positive, individuals are more inclined to save rather than spend, leading to a decrease in the propensity to consume. Conversely, a negative real deposit interest rate incentivizes spending and can stimulate consumption, potentially boosting economic growth. The propensity to consume, in turn, affects GDP, which is a measure of the total value of goods and services produced within an economy. When consumption increases, it contributes to GDP growth. Conversely, if the propensity to consume decreases, it can have a dampening effect on economic output.

Furthermore, the GDP gap, which represents the difference between actual GDP and potential GDP, is influenced by the level of economic activity. When consumption and GDP are below their potential levels, a negative GDP gap emerges, indicating an underutilization of resources. Conversely, when consumption and GDP exceed their potential levels, a positive GDP gap occurs, indicating potential inflationary pressures. This intricate loop then leads back to the

key policy rate. When the GDP gap increases, the central bank may respond by considering a decrease in the key policy rate. This reduction in the interest rate is aimed at stimulating economic activity and promoting growth. By making borrowing cheaper, the central bank encourages businesses and consumers to increase their spending, thereby boosting aggregate demand and potentially reducing the GDP gap and vice versa.

In summary, this loop demonstrates the interplay between the key policy rate, other interest rates, the real deposit interest rate, the propensity to consume, GDP, and the GDP gap. Changes in the key policy rate impact interest rates, which, in turn, influence the real deposit interest rate and consumption patterns. These consumption patterns have ramifications for GDP and the GDP gap, which then inform the central bank's decision regarding the key policy rate, completing the cycle.

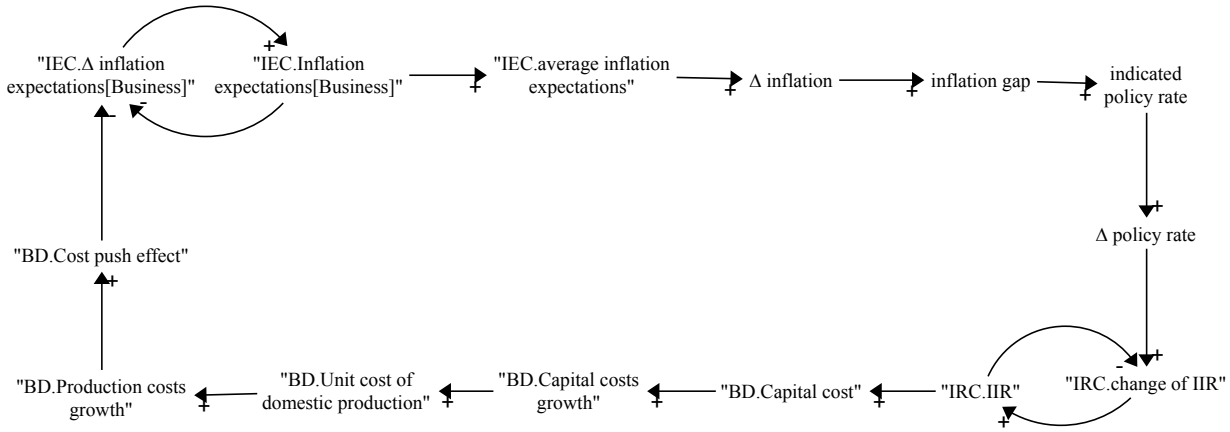

Figure 4. Interest rates loop

Another loop that balances and drives this model involves several interconnected factors (Figure 4). It begins with the impact of inflation expectations on inflation, which plays a central role in shaping economic dynamics. When inflation expectations rise, it fuels actual inflation as businesses and individuals adjust their behaviors and pricing strategies accordingly. Another key component influenced by inflation expectations is the key policy rate. Central banks, in response to inflation expectations, may adjust the key policy rate to

control inflationary pressures. When the positive gap between the target and expected inflation occurs, the central bank increases its policy rate.

Once again, the adjustment of the key policy rate, in turn, has ramifications for other interest rates - interbank, lending, and deposit. When the policy rate increases, it tends to raise borrowing costs across the financial system, impacting the interbank rate positively. The interbank interest rate through the lending interest rate indirectly affects the capital cost for businesses. The higher the lending rate is, the higher cost of borrowing for businesses. As a result, the capital costs for investments and production grow.

The growth in capital costs, in turn, positively influences the unit cost of domestic production - the higher borrowing costs translate into increased expenses related to equipment, facilities, and labor. When the unit cost of domestic production rises, it contributes to overall production cost growth, meaning their increase, which affects the profitability and pricing strategies of businesses. Moreover, production cost growth has a cost-push effect on the inflation expectations of businesses. As production costs increase, businesses may anticipate higher inflation to maintain their profit margins. This feeds back into inflation expectations, creating a cyclical relationship.

In summary, this loop highlights the intricate interplay between inflation expectations, inflation itself, the key policy rate, other interest rates, lending interest rates, capital costs, the unit cost of domestic production, production cost growth, and the cost-push effect on business inflation expectations. These factors continuously influence and balance one another, shaping the overall economic environment.

Another loop that balances and drives this model encompasses several interconnected factors (Figure 5). It begins with the influence of inflation expectations among businesses on the growth of raw materials costs. As businesses anticipate higher inflation, it leads to the growth in the prices of raw materials they procure for production. The next link in the loop is the unit cost of domestic production, which is affected by both the growth in raw materials costs and labor

costs. When raw materials costs increase, it directly impacts the unit cost of domestic production. Similarly, labor costs play a significant role in shaping the overall production costs, making them grow. The growth in production costs, in turn, influences the cost-push effect on the inflation expectations of businesses. If production costs rise, businesses may adjust their pricing strategies, anticipating higher inflation and seeking to maintain profitability. This, in turn, can feed into their inflation expectations.

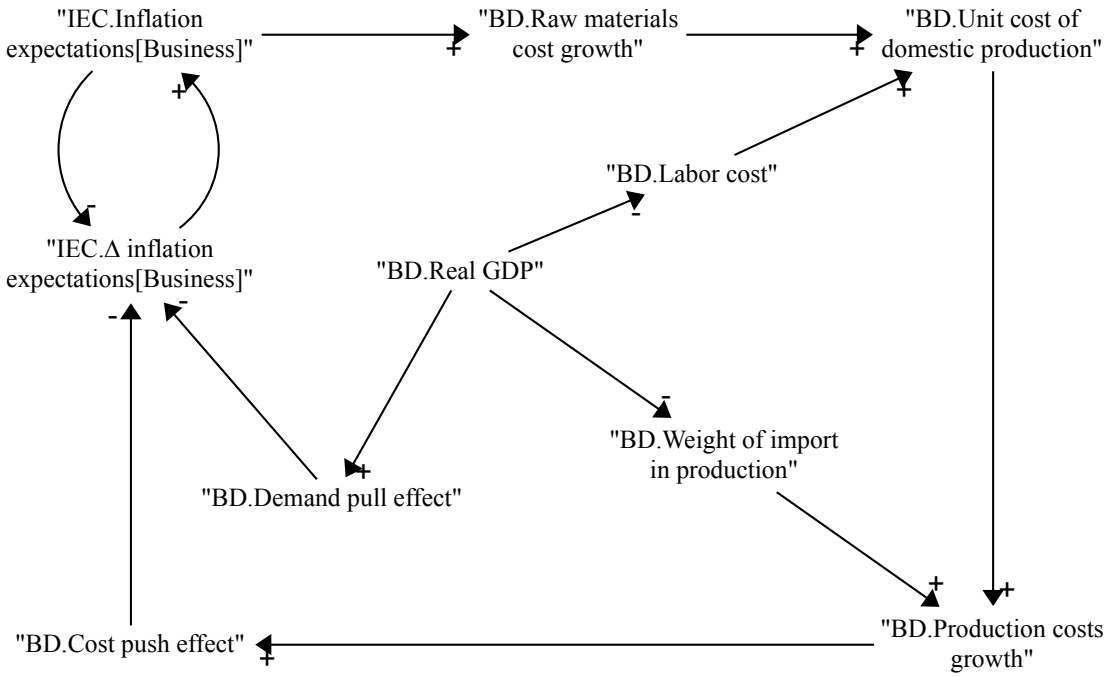

Figure 5. Feedback loop involving the cost and demand-pull effects on inflation expectations of businesses

Another influential factor in the loop is the demand-pull effect, specifically the ratio of real GDP to potential GDP. When real GDP, the actual level of economic output, exceeds potential GDP, it indicates increased demand and economic expansion. This demand-pull effect influences the inflation expectations of businesses, as higher demand potentially leads to upward price pressures.

In summary, this loop demonstrates the interplay between inflation expectations, raw materials cost growth, the unit cost of domestic production, labor costs, production cost growth, and the demand-pull effect. It highlights how businesses' inflation expectations influence raw materials costs, which further

impact the unit cost of production. The growth in production costs, in turn, affects the cost-push effect on inflation expectations, while the demand-pull effect reflects the impact of real GDP on businesses' inflation expectations.

In further research, this model will be developed and tested using real data of monetary and credit statistics of Ukraine.

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